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Car sharing as a means to raise acceptance of electric vehicles: An empirical study on regime change in automobility

Jan Schlüter *, Johannes Weyer

Technology Studies Group, Faculty of Business and Economics, TU Dortmund University, 44221 Dortmund, Germany

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ABSTRACT

Facing the dangers posed by climate change, the mobility sector needs to undergo a transition towards sustainability. One way of reducing emissions in traffic is to establish the use of electric vehicles. However, given current market shares in Germany, the envisaged regime change from traditional combustion to electric engines seems rather unlikely, triggering the search for new options for dynamic market growth. Recent research has shown consumers' insufficient knowledge and high uncertainty towards electric vehicle (EV) technology. To overcome such acceptance barriers, this study hypothesises that experience in using car-sharing services—especially EV car sharing—can lead to higher acceptance of EV technology, entailing higher market diffusion.

Using the Technology Acceptance Model, a quantitative survey with car-sharing users and non-users was conducted to assess the impact of car-sharing experience on acceptance of EVs. Furthermore, five possible predictors of EV acceptance were tested: mobility, car ownership, urbanity, ecological awareness and technophilia. Car-sharing users rated perceived EV usefulness higher than people without car-sharing experience. They also show a higher intention of buying EVs than non-users. Intention to use EVs in car-sharing schemes is positive amongst both groups. Identifying predictors of EV acceptance, results show that urbanity, ecological awareness, technophilia and car-sharing experience generally increase EV acceptance.

Study results indicate that greater EV acceptance could be achieved by addressing highly mobile individuals living in urban areas, especially by having users of traditional car sharing switch to EV car sharing. Promoting EV car-sharing services and pushing a modal shift—in terms of reducing car ownership and raising individual mobility—in urban areas can serve as a policy instrument to push the mobility regime change towards EV technology.

1. Introduction

Electric mobility and the shift towards alternative power trains of cars are perceived as opportunities to tackle the imminent dangers posed by climate change. Since combustion engines expend large amounts of fossil, non-regenerative resources, electric mobility might foster more sustainable modes of transport.

Worldwide, political initiatives are taken to support innovative and more sustainable technologies such as the electric vehicle (EV): By means of massive subsidies, Norway has become the world leader in terms of number of EVs per inhabitant, while China and the United States are leading referring to the total number of EVs per country (OECD/IEA 2016: 4, 11).

* Corresponding author.
E-mail addresses: jan.schlueter@tu-dortmund.de (J. Schlüter), johannes.weyer@tu-dortmund.de (J. Weyer).

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Germany is lagging far behind with only 98,280 electric cars in January 2018. The German government heavily promotes EVs by funding research on battery technology and subsidising the purchase of EVs with the objective of having one million electric cars on the road by 2020 (Bundesregierung, 2011). However, this aim seems very ambitious since this niche market develops only very slowly. EVs still account for less than one percent of new car registrations.

In search of solutions to increase acceptance and accelerate the adoption of low-emission vehicles, current politics as well as academic research mainly focus on financial incentives or technological advancements that might decrease purchase prices (Egbue & Long, 2012), increase vehicle range (Greaves, Backman, & Ellison, 2014) or improve the charging infrastructure (Lieven, 2014). Users' habits and attitudes are very seldom considered, although these might be decisive barriers to regime change of automobility. Insufficient knowledge of EVs on part of consumers and the high uncertainty of future markets hinder the adoption of this new technology (Franke, Bühler, Cocron, Neumann, & Krems, 2012; Blättel-Mink, Dalichau, Buchsbaum, Hattenhauer, & Weber, 2013). One strategy to overcome reluctance might be to provide low-threshold, low-cost opportunities for users to test EVs, gather practical experience and—in the long run—change their attitudes. Moreover, people interested in trying out EV technology could avoid the fixed and high cost of buying a new car (Fojcik & Proff, 2014).

Hence, our main assertion is: Car sharing as an access-based service may provide a test field for new technologies and thus contribute to overcome uncertainty, lower acceptance barriers and push market diffusion of EVs. Additionally, car-sharing services basically replace fixed acquisition costs with variable costs per itinerary, thus making the new technology more accessible. Besides cost barriers, the image of a product or service significantly determines the decision-making process of buying or using it (Han & Kim, 2010, Kleijnen, Lee, & Wetzels, 2009). This especially applies to the adoption of innovations like electric vehicles (Claudy, Garcia, & O'Driscoll, 2014) or the intention to use different modes of transport (Zailani, Iranmanesh, Masron, & Chan, 2016). Attitudes towards transport choices are influenced positively by green brand images (Zhou, 2012) or negatively by scandals like 'dieselgate' (Toklu & Ozturk Kucuk, 2017), which in turn affects—on a macro-level—the transport system's transition towards multimodality.

To test this main assertion, we developed several hypotheses, referring to the state of research in the areas of mobility (Section 2.1), transition (2.2) and technology acceptance (2.3), and combined them into our research model (2.4). Section 3 describes the methodology of an empirical study amongst users of car-sharing services in Germany, part of whom had EV driving experience. Results and analysis, based on structural equation modelling, are presented in Section 4. Section 5 summarises these results.

2. Conceptual background

Our research model is grounded in three fields of research: mobility research, transition studies and the Technology Acceptance Model (Davis, Bagozzi, & Warshaw, 1989, abbr. TAM), which is one of the most studied and widely used concepts for reliably measuring the acceptance of innovations. It assumes that the acceptance of and the intention to use innovations is significantly influenced by two variables: perceived usefulness and perceived ease of use. In our research model, these variables serve as dependent variables which, in turn, are influenced by several external factors. These independent variables are discussed in the following sections, referring to the areas of mobility, transition and acceptance research and resulting in several hypotheses.

2.1. Mobility research

2.1.1. Mobility and multimodality

Following the *mobilities turn* paradigm (Urry, 2008), social and spatial mobility are no longer considered independent. Instead, *mobility* is regarded as changing an individual's condition[1] (Canzler & Knie, 1998: 32), e.g., by modifying habits and routines. Mobility is influenced by an individual's *motility*[2], which frames—or broadens and constrains—how an individual may change his behaviour. When applying this definition to the transportation sector, motility may denote the options and prices of transport modes supplied, the skills and knowledge needed to utilise different options and usage practices[3]. Regarding technology acceptance research, the question arises as to how individual motility factors are compatible with (alternative) modes of transportation or technical innovations in mobility, such as car sharing and EV.

These socio-scientific perspectives on mobility and motility, as defined above, are closely linked to the concept of *multimodality*, which also refers to the variety of mobility options, e.g., car sharing, and the transport behaviour of individuals. Research findings from the project BeMobility in Berlin show multimodality as an important framework for raising EV acceptance: Individuals with multimodal travel behaviour recognise EV car-sharing options as an attractive add-on to their mobility needs (Kramer, Hoffmann, Kuttler, & Hendzlik, 2014: 110). Kopp, Gerike and Axhausen (2015) showed that car-sharing

[1] For example, social mobility as a vertical dimension of mobility means changing the individual's condition in society (Canzler & Knie 1998: 31).

[2] The concept *motility* subsumes (1) social conditions, (2) competencies, and (3) practices of appropriation (Canzler, Kaufmann, & Kesselring 2008: 3).

[3] For car sharing, the concept of motility indicates: (1) such options must be available, (2) people have the skills to use them (e.g. they own a license and know how to use car sharing) and (3) they understand how to use car-sharing options effectively in their daily routine. If they include car sharing in their options and their actual travel behaviour, people change their mobility.

membership and the number of weekly trips significantly correlate with multimodality and travel behaviour. We thus assume that multimodality relates to EV acceptance, considering that individuals with multimodal behaviour do not only use only one but several means of transport and tend to change routines: They adapt to different traffic situations and reflect on their transport choices. Technological limitations of EVs may be of less importance to them compared to individuals who are less multimodal.

(H01) Multimodality positively influences perceived usefulness of EVs.
(H02) Multimodality positively influences perceived ease of EV use.

2.1.2. Car ownership

Numerous studies have linked *car ownership* to individual transport behaviour and multimodality, including car-sharing use (Kopp et al., 2015, Stasko, Buck, & Gao, 2013: 262f.) and usage intention of or interest in EV (Plötz, Schneider, Globisch, & Dütschke, 2014). Since car ownership directly relates to choices of transportation and the degree of multimodality, we hypothesise that individuals who own a combustion engine car tend to be less flexible about their choice of transport mode and are routinely bound to the characteristics of traditional cars, such as longer reach. We thus assume car ownership significantly influences EV acceptance negatively. Otherwise, individuals routinely using a traditional car would consider that driving an EV is easy since it is handled in a similar way. The following hypotheses are tested in the survey:

(H03) Car ownership negatively influences perceived usefulness of EVs.
(H04) Car ownership positively influences perceived ease of EV use.

2.1.3. Urbanity

Since an individual's motility and mobility are related to available traffic options (e.g., public transport services), location and type of residence are also likely to have an effect. On the one hand, the use of EVs might seem unnecessary given the availability of different transport options in dense urban areas (Plötz et al., 2014). On the other hand, EVs can be an attractive means of individual mobility in urban areas due to the availability of multimodal transport options (Spickermann, Grienitz, & von der Gracht, 2014). Also, daily traffic routes tend to be shorter, thus better suited to EV characteristics, and a supporting infrastructure is available (e.g., charging stations). Furthermore, EVs contribute to a better quality of life in urban areas by reducing noise and emissions. Studies reported that such benefits become apparent after actual experience with EVs in an urban context, thereby reducing acceptance barriers such as negative attitudes towards pricing and driving range (Kramer et al., 2014: 109f). Thus, routines tend to change after experience with EVs in real-life situations, with users enhancing their everyday mobility given the availability of other modes of transport (Kramer et al., 2014: 110).

Given these arguments, we assume that EV acceptance will be higher amongst residents of urban areas.

(H05) Urbanity positively influences perceived usefulness of EVs.
(H06) Urbanity positively influences perceived ease of EV use.

2.1.4. Eco-awareness

Potential ecological advantages are key marketing factors for EVs. Studies report ambivalent results regarding the importance of potential customers' eco-awareness: A majority of survey respondents considers sustainability when purchasing a new vehicle (Egbue & Long, 2012: 723), especially in the case of hybrid cars (Schaefers & Esch, 2012: 92). However, Graham-Rowe et al. (2012) found that consumers expressed doubts about the sustainability of EVs, questioning fast adoption. Field studies on new EV users report that ecological factors such as low emissions and noise are only recognised by consumers after actual use of EVs (vgl. Blättel-Mink et al., 2013: 279; Dudenhöffer, 2013a: 116; Kramer et al., 2014: 108). Given these ambiguous results, we intend to measure if consumers' ecological awareness leads to higher acceptance of EVs.

(H07) Ecological awareness positively influences perceived usefulness of EVs.
(H08) Ecological awareness positively influences perceived ease of EV use.

2.2. Innovation diffusion and transition of socio-technical systems

Transition research is the second field that helps us to derive hypotheses concerning the role of car sharing in changing the automobility regime, thus going beyond individual acceptance, but reflecting the role of individuals as part of a more encompassing societal transformation process.

2.2.1. Phase models

The evolution of socio-technical systems has been depicted by means of phase models that put emphasis on the creation of markets as the final stage of the innovation journey (Tushman & Rosenkopf, 1992; Van de Ven, Polley, Garud, & Venkataraman, 1999; Loorbach, 2007). Weyer's (1997: 35ff.) phase model of socio-technical evolution distinguishes three stages: emergence (creation of the socio-technical core), stabilisation (development of a functioning prototype in protected niches) and diffusion (emergence of a dominant design and, finally, of mass markets). Transitions from one stage to another

are the result of social construction, achieved by means of "closure" (Pinch & Bijker, 1984) in actor networks. However, radical innovations may fail if the diffusion stage cannot be reached, as in the case of the EV, which nowadays is somewhere between stabilisation and diffusion. In Weyer's phase model, the involvement of users and their needs are regarded as crucial elements that may help to achieve the final stage: diffusion into mass markets. We assume that car sharing can be considered as a kind of test market that brings together users, producers, service providers and others. It might help to integrate users' needs and interests and thus achieve the social construction of a new market.

2.2.2. Innovation diffusion

Rogers' theory of innovation diffusion (2003: 267ff.) confirms the argument that innovation adoption typically starts in niche markets. He puts even more emphasis on the transition to the final (diffusion) stage, which is facilitated by five crucial characteristics of technical innovations: relative advantage, compatibility, complexity, trialability and observability (Rogers, 2003: 229–256). Referring to the latter two, car sharing can again be regarded as a suitable means of increasing EV adoption: Users of EV car sharing can test the innovation and its potential benefits in everyday life, thus losing uncertainty and gaining knowledge of and trust in EVs.

A comprehensive EV car-sharing system in urban areas would raise awareness for the new technology by being visible in daily traffic (observability). Additionally, it would provide consumers opportunities to experiment with the innovation and to test it in daily use (trialability), thereby checking compatibility with their individual habits and routines.

2.2.3. Technophilia of niche-actors

Both models point out the major role of users that test and adopt new technologies at a very early stage and contribute to the development of niche markets. Hence, consumers' attitudes towards technical advancement and enhancements are an important factor when discussing early market entry of high-tech innovations. Such mindsets and attitudes are referred to as innovativeness[4] or *technophilia*, which involves not only emotions towards innovations, but also motivations to access innovative products or services. The early adoption of technical innovations such as EVs can be regarded as symbolic or expressive of technology-oriented consumers interested in adopting new high-tech products like EVs and trying out their functions *despite* given limitations.

Recent research has demonstrated that individuals with a strong degree of innovativeness are highly interested in mobility innovations like EV car sharing (Wappelhorst, Sauer, Hinkeldein, Bocherding, & Glaß, 2014; Ruhrort, Steiner, Graff, Hinkeldein, & Hoffmann, 2014). Schuitema, Anable, Skippon and Kinnear (2013: 46ff) found that instrumental, hedonic and symbolic attributes of electric vehicles positively influence survey respondents' perceptions. Qualitative (Blättel-Mink et al., 2013: 280) as well as quantitative research (Fazel, 2014: 289) has identified the significant impact of technophilia and intrinsic motivation on potential EV usage. Thus, the following hypotheses are put forward:

(H09) Technophilia positively influences perceived usefulness of EVs.
(H10) Technophilia positively influences perceived ease of EV use.

2.2.4. MLPs

The multi-level perspective (MLP) also sustains the concept of field trials in protected niches as test beds for radical innovations (Geels & Schot, 2007). The MLP is a comprehensive concept for analysing socio-technical regime change, e.g., replacement of the current automobility regime (resting on combustion engines) by a regime of more sustainable mobility (with EVs and others, cf. Hoffmann, Weyer, & Longen, 2017). The model consists of three layers:

- the socio-technical regime, which represents the dominant "way of doing things" (Geels, 2011: 31), sustained by a strong actor network and vested interests of different players;
- the landscape, or socio-cultural context, affecting regime as well as niches;
- and, finally, the niche, where radical novelties may emerge and develop in protected spaces that may eventually challenge and even replace the current regime.

Depending on the state of regime, niche and landscape, different transformation pathways are possible, as Van Bree, Verbong and Kramer (2010) described in the case of the electric vehicle. The existence of several possible pathways indicates that it is possible to shape which pathway will unfold: In the case of EVs, this heavily depends on governmental regulations as well as changes in consumers' habits and routines regarding mobility.

As the two aforementioned concepts of Rogers' theory of innovation diffusion and Weyers' phase model of socio-technical evolution, MLP emphasises the importance of niches as test markets where consumers can get involved and gain experience with new technologies and mobility patterns, which may be the first step to changing their attitudes and routines. Niches also allow experimenting with new technologies and business models. If successful, niches may mature and finally challenge

[4] For example, Vandecasteele and Geuens (2010: 316) developed an innovativeness scale including hedonic, functional, social and cognitive dimensions.

the current regime. Again, we propose that car sharing may support user acceptance of EVs and thereby drive market diffusion of this new technology.

2.2.5. Acceptance barriers and car-sharing experience

The aforementioned theoretical concepts highlight consumers' attitudes and mobility routines as crucial elements of socio-technical transitions, sustaining our assertion that niche markets with EV car sharing positively affect the adoption factors "trialability" and "observability" in support of innovation diffusion (Rogers, 2003).

Regarding various acceptance barriers, the market diffusion of EVs is not self-evident. Main barriers still derive from battery technology: Crucial problems for potential customers include low battery range (e.g., Dudenhöffer, 2013a: 112f., Egbue & Long, 2012: 721) as well as the high purchase price of the car due to the expensive battery (e.g., Dudenhöffer, 2013a: 31, Egbue & Long, 2012: 721). Overall, from a customer's perspective, EVs are considered to deliver *lower* performance compared to combustion engine vehicles while involving *higher* asset costs. Still, many participants in field studies show a high interest in electric vehicles and their technology (e.g., Egbue & Long, 2012: 724; Franke et al., 2012: 302).

Aside from technological limitations, empirical research generally states a high uncertainty towards and insufficient knowledge of the innovation and its characteristics. Egbue and Long, who surveyed mostly technology-oriented consumers, claim that "uncertainty associated with the EV battery technology and sustainability of the fuel source" (2012: 724) prevails. Interviewees bemoan an information deficit regarding electric vehicles (Blättel-Mink et al., 2013: 278), and industry experts mention a limited knowledge on the part of customers (Peters & Dütschke, 2010: 30) as one of the main acceptance barriers. Noteworthy features such as fast acceleration and low noise emissions are widely unknown, as stated by Dudenhöffer (2013b: 209). Franke et al. (2012) assert that mobility routines and a push to modify them are key to changing the transportation landscape. They describe this change as "a social adaption process that could be supported by giving more people the chance to experience EMSs [Electric mobility systems, author's note] in real-life" (303) with regard to trialability of the innovation.

Test markets, which allow for low-cost experience with innovative technology in everyday life, help to reduce uncertainty as users get familiar with and gain trust in EVs.. Thus, experience in using car-sharing services with electric vehicles may act as a direct means to raise EV acceptance. Additionally, users of (also non-EV) car-sharing services may be more open to innovative mobility concepts and technologies like EVs and adapt to different transport situations more flexibly, thus being less bound to specific mobility routines and less concerned about the technological limitations of EVs compared to combustion engine vehicles.

We therefore postulate that *car-sharing experience* directly influences EV acceptance (based on two factors: perceived usefulness and perceived ease of use, cf. Section 2.3).

(H11) Car-sharing experience positively influences perceived usefulness of EVs.
(H12) Car-sharing experience positively influences perceived ease of EV use.

2.3. Technology acceptance model

The third area providing insights for deriving hypotheses is the TAM, which has been applied in various fields of research (see Fazel, 2014: 103, 125f.), including mobility and transportation research. The technological characteristics of EVs discussed above can be directly linked to acceptance variables evaluated in the TAM. Low battery range and high price as well as low noise and pollution can be linked to perceived usefulness of EV, while limited knowledge and uncertainty about range or charging may interrelate with perceived ease of EV use.

Dudenhöffer worked directly with the TAM to measure EV acceptance. One of her major findings is that personal experience with EVs induces a positive effect on perceived usefulness of the vehicle (2013a: 113). Fazel's survey regarding the interdependence of car-sharing use and EV acceptance found no significant difference between user groups (2014: 133ff.). However, this survey was conducted in mid-2012 and the context has changed rapidly since then: EV serial models have been introduced to the mass market and car-sharing services have been successfully established in urban areas (BCS, 2015). Fazel recommended re-evaluating his research findings at a later date (2014: 305). Thus, we review his findings based on the assumption that altered market conditions, especially regarding car-sharing use, may have changed customers' perceptions of mobility innovations like EVs.

2.3.1. Dependent variables

Empirical evidence supports the TAM's main assertion that *perceived usefulness* and *perceived ease of use* are major factors influencing the *behavioural intention to use*, which is the main indicator of technology acceptance. These three variables constitute the dependent variables in our research model.

The TAM proposes that *perceived usefulness* and *ease of use* correlate with the *behavioural intention to use* the innovation.

(H13) Perceived usefulness positively influences behavioural intention to use EVs.
(H14) Perceived ease of use positively influences behavioural intention to use EVs.

2.4. Access or ownership? [5]

Despite a long-lasting debate on the sharing economy (Rifkin, 2000, Schaefers, Lawson, & Kukar-Kinney, 2015), the question remains unresolved as to whether experience with new technologies by means of access-based services will promote the option "ownership" (of EVs) or "access" (by means of EV car sharing). Although this issue is not at the core of our study, we investigate two additional hypotheses:

(H15) Car-sharing experience leads to greater intention to buy EV.
(H16) Car-sharing experience positively influences intention to use EV car sharing if available.

By means of hypotheses H15 and H16, we can also examine if car-sharing experience has a *direct* impact on buying EVs or using them in a car-sharing scheme. These hypotheses are not included in the following research model and are assessed separately.

2.5. Research model

Our main research model is an extension of the basic TAM and includes three dependent variables (PU, PE, BI) indicating general EV acceptance (cf. Fig. 1, hypotheses H13/H14). It comprises six independent variables used to test hypotheses H01 to H12: *multimodality*, *car ownership*, *urbanity*, *ecological awareness*, *technophilia* and *car-sharing experience*.

Car-sharing experience may also be linked to other independent variables discussed in our model like *urbanity*, due to the availability of different transport options, *multimodality*, which is promoted by these options, or *car ownership.*[6] Thus, interrelations between *car-sharing experience* and other independent variables are tested in our research model.

3. Methodology

3.1. Sample

The following analysis is based on quantitative methods. The survey was conducted between December 2014 and January 2015 in Germany and the sample includes 124 participants. The small sample size is due to the fact that a novel—and rarely available—technology is being assessed in the early stage of a technological transition phase. Therefore, recruitants including early adopters of the new technology (EV) and service (car sharing) may have special attitudes and opinions towards these innovations.

Participants were drawn from:

(1) online discussion forums addressing topics of automobility, sustainability, electromobility or car sharing;
(2) groups of the social network XING related to these topics; and
(3) the website of cambio CarSharing, the car-sharing service provider we collaborated with. With a customer base of more than 44,000 in Germany, it is one of the country's biggest car-sharing companies. The survey was posted online in the member area of the Cambio website and was made available to customers in the cities of Aachen, Cologne, and Hamburg, where Cambio provides access to EV car sharing, too.

In our sample, 78% of the 124 participants are male. The largest age group represents people between 38 and 47 years old (30%), the two younger age groups jointly account for 44%, and the group of users older than 47 years represents 27%. Of the respondents, 61% own a college degree, 20% a high school degree, and the remaining have a lower school education. With regard to net income, the largest group (31%) earns between 1300 and 2600 euros, 26% earn less than 1300 euros, and 43% earn at least 2601 euros.

Of the 124 participants, 58 have used car-sharing services at least once (47%) and 27 have used an electric vehicle (22%). The remaining 39 survey respondents have never used car-sharing services or an electric vehicle (31%).

3.2. Measurement and operationalisation

Six independent constructs were used for the survey, the corresponding hypotheses being based on current state of research as pointed out in the previous section (cf. Fig. 1). Except for the variable *car ownership*, every construct was operationalised by multi-item-measurement, comprising two to eight items. All constructs except *multimodality* (nominal) and *urbanity* (ordinal) were developed with adjustment scales, i.e., metric scales of measurement based on the Likert scaling scheme. Rating of the single items was defined from -10 to +10. This scale enables (1) more detailed results regarding

[5] The authors are greatly indebted to Tobias Schaefers, whose research interests include acceptance of access-based services. He critically commented a prior version of this paper.
[6] See Section 2.1 for references discussing the linkage between car sharing and these variables.

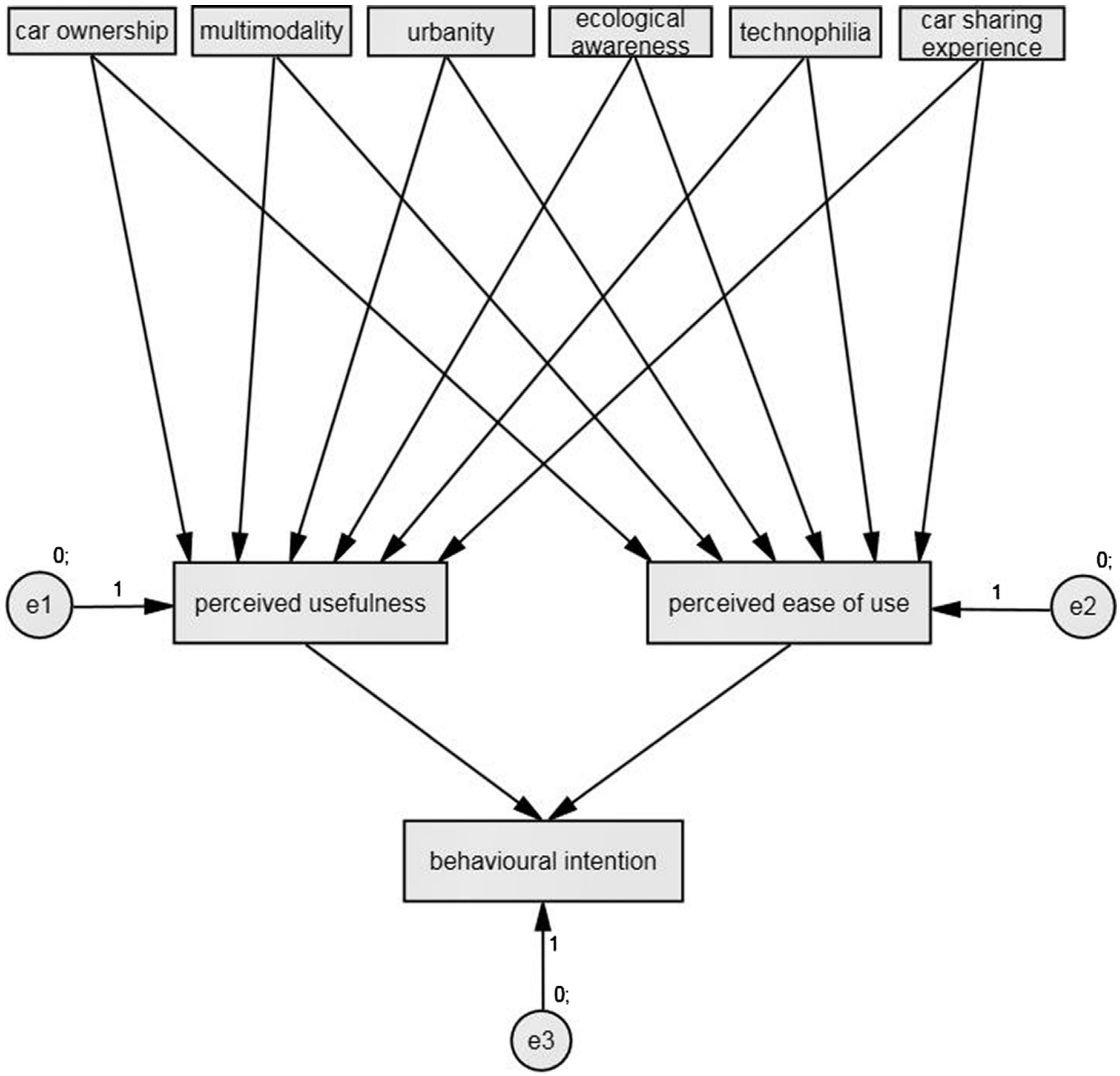

Fig. 1. Research model. (Hypothesised interrelation pathways between independent variables are not displayed to enhance clarity and readability of the figure. For covariance results, see Section 4.1).

the mean values of participant groups and the sampled statements, and (2) the evaluation of non-point, spontaneous and possibly subconscious opinions. As opposed to five-point rating scales, the ratings are not bound to defined claims or grades, thus survey participants are forced to rate their statements intuitively.

Of the 124 respondents, 31 did not completely answer all survey questions, mostly with a non-response rate of less than 5%. All items and constructs data were tested on their random occurrence with Little's MCAR test. There were no significant results, thus, every missing item and construct occurs completely randomly. Missing values were replaced using the EM method in quantitative and interval-scaled variables if they were normally distributed. Otherwise, the variables were complemented with mean substitution.

Following the common quality criteria of empirical research (Bortz & Döring, 1995: 180), the study is given objectivity by choosing an online survey as research method. This enables respondents to participate in the survey independently and uninfluenced by the scientist. Study reliability is achieved by transparently displaying the used methods and measurements for the purpose of repeating the measurement. Complete reliability is not achievable in practice due to measuring errors and other error interferences (Bortz & Döring, 1995: 181). Item reliability was tested in SPSS with dimensional analysis of items by measuring indicator reliability through factor scores and communalities (Huber, Herrmann, Meyer, Vogel, & Vollhardt, 2007: 86ff). If the value was below 0.4 (communalities) and 0.6 (factor score), the item would be removed (see Huber, Herrmann, Meyer, Vogel, & Vollhardt, 2007: 93 for common values). Construct validity was measured with KMO values

and Cronbach's alpha. KMO values show if items in one construct are suited for factor analysis, and Cronbach's alpha tests measure if single items fit together as a construct (Bühl, 2012: 622). Especially with newly developed constructs as in this survey, lower valued KMO scores are common; thus, a KMO value of at least 0.5 was accepted. For reliability of metric or quasi-metric scaled constructs, Cronbach's alpha values of at least 0.6 were accepted. After analysis, 3 of 35 indicators were removed due to low communalities and factor scores. The KMO and Cronbach's alpha[7] values listed in the following section represent data after elimination of these indicators.

In the following section, we describe the operationalisation of variables used for the research model.

3.2.1. Independent variables[8]

3.2.1.1. Car ownership (COwn) and multimodality (Mod). The variable *car ownership* (COwn) was assessed with a binary question asking probands if they own a car. *Multimodality* (Mod) was measured by inquiring about the survey respondents' usual choice of transportation (car, public traffic, bicycle, other) in general and in specific everyday situations (work, leisure, errands). For example, people using different options in all situations are highly multimodal.

For every dimension, one variable was coded out of existing data. These variables load on one factor (KMO-value = 0.513, explained variance of 61.95%).

3.2.1.2. Urbanity (Urb). Indicators for the construct *urbanity* (Urb) are based on concepts developed by the urban sociologist Louis Wirth (1938), who defined urbanity by residence density, population size and social heterogeneity. Survey participants were asked about social heterogeneity (age, cultural and ethnic diversity, nationality) in their neighborhood, the distance of their residence to the inner city, the kind and number of shops and cultural institutions in their neighborhood and the population size of the city or village they live in. As with MOD, the variable URB consists of different scales of measurement, thus a Cronbach's Alpha analysis was not conducted. The items load on one factor (KMO-value = 0.659, explained variance of 48.77%).

3.2.1.3. Ecological awareness (EA). The construct *ecological awareness* (EA) is based on individual values and attitudes of actors such as environment protection, climate change and eco-mindedness. Likert scale items in this construct are based on the scale of ecological awareness by Diekmann and Preisendörfer (1998: 446). The items load on one factor (KMO = 0.828, explained variance of 45.88%). With a Cronbach's alpha value of 0.841, the construct can be rated as very consistent.

3.2.1.4. Technophilia (Tech). The construct *technophilia* (Tech) was measured with eight items developed by Weyer, Fink and Adelt (2015: 203), such as technology enthusiasm, technology scepticism and self-assessment of competencies regarding technology use. The items load on one factor (KMO = 0.754, explained variance of 46.10%), thus the construct can be rated as reliable (CA = 0.761).

3.2.1.5. Car-Sharing experience (CS-E). People were asked if they do or did use car-sharing services personally. Additionally, if using these services, they were asked about the type of engine involved (combustion, electrical, other). The questions allowed dividing respondents into two user groups—people with and without car-sharing experience—to measure differences between these groups (hypotheses H15-H16). The user group with car-sharing experience mainly included members (and thus possibly regular users) of a car-sharing service as the survey respondents were partly recruited by the car-sharing provider Cambio, that made the survey available in the members' section of its website.

3.2.2. Dependent variables

3.2.2.1. Perceived usefulness, perceived ease of use and behavioural intention. The three TAM variables *perceived usefulness* (PU), *perceived ease of use* (PEOU) and *behavioural intention* (BI) are indicators of general technology acceptance. The accompanying items were initially developed by Davis (1989: 340) to measure acceptance of information technology and were adjusted here to fit the EV context. Some redrafted statements are based on TAM items by Fazel (2014: 213) and Dudenhöffer (2013b: 126). For the construct *perceived usefulness* of EVs, items load on one factor (KMO = 0.591, explained variance of 57.84%) and the construct can be rated as reliable (CA = 0.630). For the construct *perceived ease of EV use*, items load on one factor (KMO = 0.649, explained variance of 51.75%), thus the construct can be rated as reliable (CA = 0.650). For the construct *behavioural intention* to use EV, items load on one factor (KMO = 0.630, explained variance of 58.30%) and the construct can be rated as reliable (CA = 0.607).

3.2.3. Additional variables

Referring to the aforementioned discussion on whether car sharing is an alternative to or a promotion of ownership, we constructed two additional variables in order to measure if the survey groups (e.g., people with or without car-sharing experience) form different intentions towards using EV car sharing or buying EVs.

[7] Cronbach's alpha results are only displayed with constructs that are based on Likert scales, thus metric scaling, since results are not reliable otherwise.

[8] The exact survey questions are displayed in the appendix.

3.2.3.1. Intention to use EV car sharing. This construct based on Fazel (2014: 215) was used to assess personal or subjective attitudes of survey participants. These were asked (1) if they could imagine using an EV car-sharing system if they had access to it and (2) if they would be open to using EV car sharing to assess suitability of EV technology in daily use. The items load on one factor (KMO = 0.500, explained variance of 88.00%) and the construct can be rated as reliable (CA = 0.862).

3.2.3.2. Intention to buy EV. Since temporary use is only one step in the process of adopting new technologies, we asked the survey participants if they would buy an EV as their next car.

4. Analysis and results

4.1. Main research model

4.1.1. Model validation

SPSS AMOS was used to test structural equation modelling. Following Hu and Bentlers (1999) combination rules of reporting model fit indices for sample sizes with $n < 250$, the following CFA data is reported: Based on the final sample size of 124, the comparative fit indices (RMSEA) = 0.063, (CFI) = 0.957 and (IFI) = 0.971 indicate acceptable model fit, which is further supported by absolute fit of (Chi-square/d.f.) = 1.484. The accompanied chi-square probability level of $p = 0.168$ indicates acceptable model fit. After eliminating non-significant interrelations (as seen below), increased fit values with (RMSEA) = 0.042, (CFI) = 0.964, (IFI) = 0.973 and (Chi-square/d.f.) = 1.218 with a probability level of $p = 0.253$ are reported for the modified research model, indicating better fit of the modified model.

4.1.2. Interrelations of independent variables

Unstandardised covariances show multiple significant interrelations between independent model variables (Table 2, Fig. 2). Standardised correlations (Table 1), which can be better interpreted, show identical interrelations, especially between *multimodality* and *car-sharing experience* as well as *urbanity* and *car-sharing experience*. Following Cohen (1988), both indicate a positive medium effect. We assume that *urbanity* and *multimodality* both affect *car-sharing experience*, since this direction of the relationship fits results of previous studies on car-sharing use (cf. Section 2.1). Car-sharing experience may increase in urban areas not only because of greater availability, but also due to higher flexibility and comfort arising from free-floating car-sharing services, which only exist in highly urbanised areas, or to different public transport options.

Second, *multimodality* correlates with *car-sharing experience*. This result supports theoretical statements in Section 2.1, as people who are more mobile show more openness to alternative transport choices and adapt more flexibly to different traffic situations. Since they change routines more readily, they may be a key target group when pushing EV acceptance—since EV use also presupposes changing mobility habits due to different charging infrastructure and range.

With a small correlation effect, *urbanity* and *car ownership* as well as *car-sharing experience* and *car ownership* relate negatively. We suppose that the greater availability of transport choices in more urbanised areas not only positively influences car-sharing use, but also negatively affects car ownership. Given greater transport options, the need for an own car is reduced. Tagging car sharing as one of these multimodal transport options, it is expected that this specific option also negatively relates to car ownership.

Given these interrelations, the important question arises as to which independent variables influence acceptance of electric vehicles and whether *car-sharing experience* has a causal effect on EV acceptance regardless of other related variables. Therefore, the next section focuses on significances and causal effects.

4.1.3. Analysis of causal effects

To analyse hypothesised causal effects in the research model, theoretically derived hypotheses (cf. Section 2) and measured effects using structural equation modelling are compared regarding significance, effects and direction.

Regression weights (Table 3) show that the dependent variable *perceived usefulness* (of EVs) is significantly influenced by independent variables *ecological awareness* and *car-sharing experience*. The direction of these interrelations is positive, as hypothesised. The dependant variable *perceived ease of use* (of EVs) is significantly influenced by independent variables *urbanity* and *technophilia*. Both interrelations are positive. Also, *perceived usefulness* and *perceived ease of use* influence *behavioural intention* (of using EVs) significantly.

Regression weight estimates represent direct effects and show the effect size of path dependencies between independent and dependent variables.[9] With a direct effect size of 1.381, *car-sharing experience* is a positive predictor of *perceived usefulness*. Thus, with every one-unit increase of the variable *car-sharing experience* (representing experience, since the variable is dichotomous), the value of *perceived usefulness* of EVs increases by 1.381. For the influence of *ecological awareness* on *perceived usefulness*, a 1.324 effect size is reported. However, standardised regression weights indicate that ecological awareness shows a larger effect (0.290) compared to car-sharing experience (0.177) when eliminating differences in scaling. Also, *car ownership* negatively influences *perceived usefulness* of EVs (−1.260). This leads to the assumption that people accustomed to their own

[9] There is no common ground in scientific literature for heuristic or cutoff values to interpret standardized regression weights. Therefore, after testing for significance, rather than interpreting absolute rankings of standardized effect sizes, relative differences of these measurements are discussed.

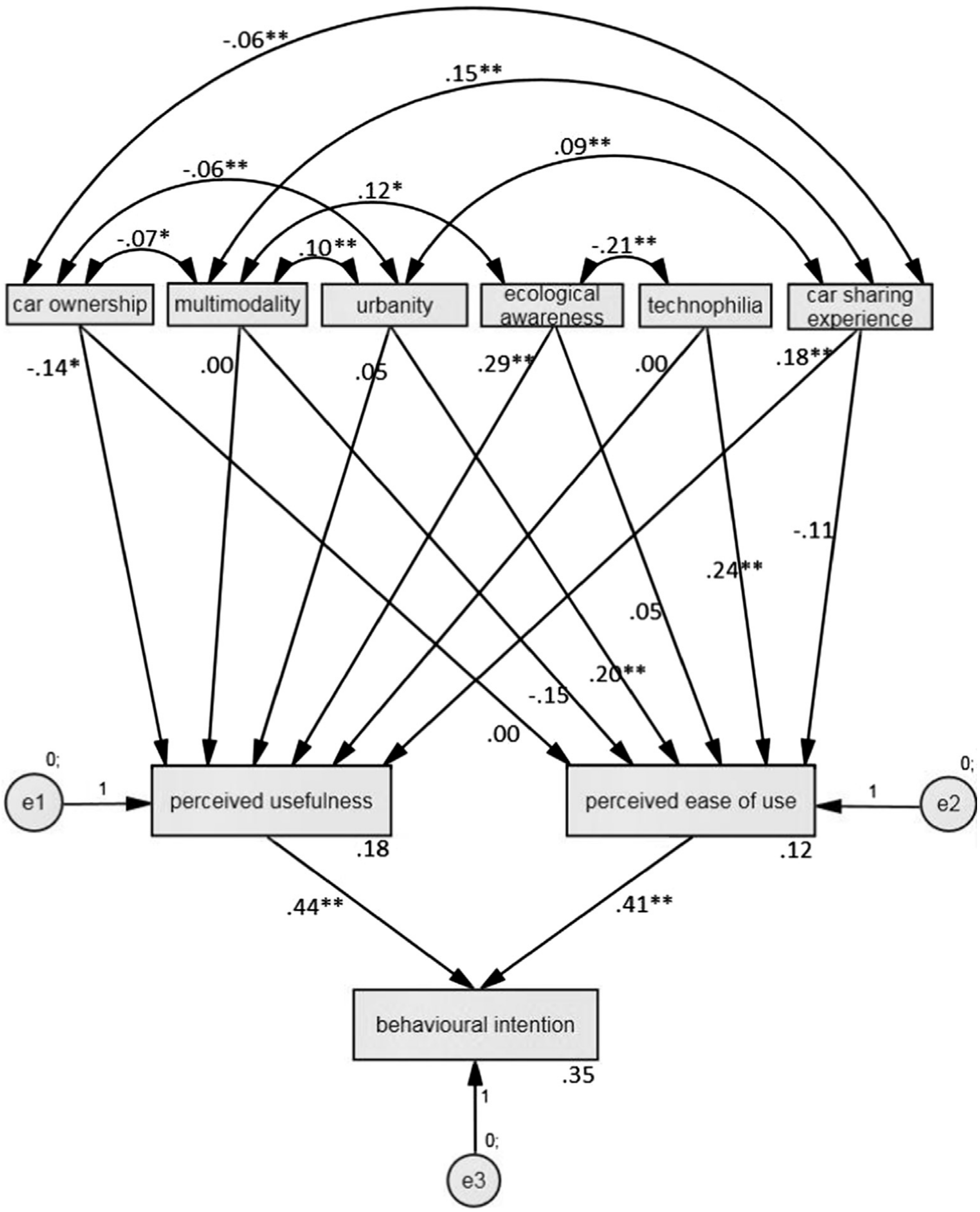

Fig. 2. Standardised regression weights in research model.

(combustion engine) cars' technical characteristics (such as range) share a different mindset towards mobility innovations compared to other groups in our sample, since *car ownership* also negatively interrelates with *car-sharing experience* (which in turn positively influences *perceived usefulness*).

For *perceived ease of use*, *urbanity* (1.150) shows a higher unstandardised effect than *technophilia* (0.747); standardised regression weights report effect sizes of 0.196 for *urbanity* and 0.242 for *technophilia*. According to Cohen (1992), a squared multiple correlation value of 0.12 is interpreted as showing a small effect with variance explanation of 12% of the dependant variable *perceived ease of use* in the research model. The squared multiple correlation value of 0.18 for *perceived usefulness* is interpreted as indicating a medium effect with variance explanation of 18% through independent variables. This shows that other possible major factors of EV acceptance, e.g., price, car design, range or charging infrastructure are not or only indirectly represented in the research model.

Multimodality is the only variable that interrelates with *car-sharing experience* but not with any of the dependent variables measuring EV acceptance. This result may indicate our sample group of people with car-sharing experience have some common characteristics and attitudes. Interrelations of independent variables indicate that these people may be highly multimodal, live in denser urban areas, are ecologically aware and tend to not own a private car. *Multimodality*, which does

Table 1
Correlations of constructs.

	COwn	Mod	Urb	EA	Tech	CS-E
COwn	1.00					
Mod	−0.16	1.00				
Urb	−0.27	0.19	1.00			
EA	−0.04	0.14	0.11	1.00		
Tech	0.04	−0.02	0.07	−0.25	1.00	
CS-E	−0.26	0.30	0.33	0.14	0.02	1.00

COwn: Car Ownership
Mod: Multimodality
Urb: Urbanity
EA: Ecological Awareness
Tech: Technophilia
CS-E: Car sharing experience

Table 2
Covariances of constructs.

			Estimate	S.E.	C.R.	p
COwn	↔	Mod	−0.070	0.040	−1.734	*
COwn	↔	Urb	−0.063	0.022	−2.912	**
COwn	↔	EA	−0.013	0.034	−0.388	0.698
COwn	↔	Tech	0.063	0.134	0.472	0.637
COwn	↔	CS-E	−0.058	0.021	−2.816	**
Mod	↔	Urb	0.097	0.048	2.029	**
Mod	↔	EA	0.119	0.077	1.539	*
Mod	↔	Tech	−0.018	0.089	−0.199	0.842
Mod	↔	CS-E	0.148	0.047	3.172	**
Urb	↔	EA	0.05	0.04	1.233	0.217
Urb	↔	Tech	0.124	0.159	0.783	0.434
Urb	↔	CS-E	0.085	0.025	3.424	**
EA	↔	Tech	−0.208	0.079	−2.637	**
EA	↔	CS-E	0.059	0.039	1.537	0.124
Tech	↔	CS-E	0.04	0.151	0.264	0.792

S.E.: standard error.
C.R.: Critical Ratios.
*: $p \leq 0.10$/**$p \leq 0.05$.

Table 3
(Standardised) regression weights.

			Estimate	S.E.	C.R.	p	Estimate*
PU	←	COwn	−1.260	0.764	−1.650	*	−0.143
PU	←	Mod	0.017	0.338	0.049	0.961	0.004
PU	←	Urb	0.344	0.661	0.520	0.603	0.046
PU	←	EA	1.324	0.392	3.377	**	0.290
PU	←	Tech	−0.016	0.331	−0.049	0.961	−0.004
PU	←	CS-E	1.381	0.709	1.948	*	0.177
PEoU	←	COwn	0.031	0.626	0.049	0.961	0.004
PEoU	←	Mod	−0.456	0.277	−1.648	0.242	−0.148
PEoU	←	Urb	1.150	0.542	2.120	**	0.196
PEoU	←	EA	0.192	0.321	0.597	0.550	0.053
PEoU	←	Tech	0.747	0.271	2.751	**	0.242
PEoU	←	CS-E	−0.687	0.581	−1.182	0.237	−0.112
BI	←	PU	0.099	0.023	4.204	**	0.439
BI	←	PEoU	0.115	0.030	3.882	**	0.405

Estimate: standardised regression weight estimate*
S.E.: standard error.
C.R.: Critical Ratios.
*: $p \leq 0.10$/**$p \leq 0.05$.

not correlate directly with EV acceptance, is highly tied to most of the other independent variables. Thus, multimodality may be an indicator of the aforementioned sample group or its characteristics, but it plays no important role in measuring EV acceptance directly. The other independent variables, however, have a direct effect on at least one of the dependent variables, indicating that these variables interrelate with EV acceptance independently of car-sharing experience.

TAM variables *perceived usefulness* (0.439) and *perceived ease of use* (0.405) show the highest standardised effects, supporting our application of the Technology Acceptance Model. The squared multiple correlation value of 0.35 for *behavioural*

intention is interpreted as showing a large effect on EV acceptance with variance explanation of 35% through variables *perceived usefulness* and *perceived ease of use*.

Considering these causal effects, *car-sharing experience* is thus interpreted to have a small but significant effect on EV acceptance in our research model through the variable *perceived usefulness*: It is assumed that people with car-sharing experience assess electric vehicles as more useful due to EV compatibility with shorter driving distances in urban areas. Also, negative characteristics of electric vehicles like smaller range and charging infrastructure may have less influence on car-sharing users since these are more mobile and can easily turn to different transport options when EV use is not the best choice. We also checked if this correlation is influenced by EV experience and did not find a significant difference using a one-way ANOVA ($F(2,82) = 1.897$, $p = 0.157$). Post-hoc analyses showed that people with experience in both car-sharing services and EVs ($M = 2.80$, $SD = 3.00$) or just with EVs ($M = 0.89$, $SD = 5.04$) do not rate *perceived usefulness* of EV significantly higher or lower than people using combustion engine car-sharing services ($M = 2.20$, $SD = 2.83$). This result supports the assumption that people using car-sharing services have a mobility mindset that is compatible with EV characteristics and thus consider it more useful.

However, *perceived ease* of EV use does not significantly increase with *car-sharing experience*. This more technical aspect of EV acceptance, measured using variables that assess the difficulty of handling, driving and charging EVs, is rather influenced by *technophilia* and *urbanity*.

Variables *ecological awareness* and *technophilia* are shown to have a significant effect on EV acceptance, although they are the only two independent variables that do not interrelate with *car-sharing experience* (cf. Table 2). This may be caused by the rapidly changing distribution of car-sharing customers in recent months and years, with most new customers using the innovative free-floating option. The non-significant results may thus indicate that the new user group of free-floating customers holds attitudes and motivations towards using car sharing that are less influenced by environmental consciousness or technophilia. Therefore, when attempting to raise EV acceptance through access-based car-sharing services, it may not be appropriate to primarily target ecologically aware and technophile people. These may form a different EV target group that could be addressed otherwise. In summary, results indicate that EV acceptance of study participants with car-sharing experience rather relies on habits (like mobility habits) than attitudes (like eco-friendliness).

4.2. Additional results

Additional hypotheses H15 and H16 measure—separately from TAM—a direct impact of car-sharing experience on behavioural intention. Participants with and without car-sharing experience were asked if they would use an EV car-sharing service if it was offered in their region, rating their intention on a scale from −10 to +10. Mean values of ANOVA post-hoc tests based on Games-Howell are as follows (Table 4):

The ANOVA is significant ($p = 0.008^{**}$). There is a strong intention to use such services if offered, as indicated by the highly positive mean values, especially of car-sharing users. Although significantly lower, values of non-experienced people show they also are open-minded about EV car-sharing services, rating their intention with a value strongly above zero.

Participants were also asked about their intention to buy an EV as their next car (answers: 1 = no intention, 2 = ambivalent, 3 = intention to buy). Mean values are as follows (Table 5):

The ANOVA is significant ($p = 0.080^{*}$). Car-sharing users do not show a significantly higher buying intention than non-experienced participants. However, EV car-sharing users—a group not yet owning an EV—report a significantly higher buying intention than non-experienced users, indicating that use of EV car-sharing services plays a role in changing opinion to buy an EV as *next* car. Results imply that car-sharing users could be seen as a target group for automobile companies since they also tend to own a car rather than only sharing.

4.3. Summary of hypotheses results

Hypotheses results are summarised as follows (Table 6):

Table 4
Intention to use EV car sharing.

	(1) No experience	(2) Car sharing experience
Intention to use EV CS	4.15 (** to 2)	7.86 (** to 1)

*: $p \leq 0.10$/$^{**}p \leq 0.05$.

Table 5
Buying intention.

	(1) No experience	(2) Car sharing experience	(3) EV car sharing experience
Buying intention EV	1.67 (* to 3)	2.00	2.13 (* to 1)

*: $p \leq 0.10$/$^{**}p \leq 0.05$.

Table 6
Hypotheses results.

Hyp.	Hypothesized causal effect	Significance and significance level	Direct effect
H01	Car ownership → PU	* (supported)	−0.143
H02	Car ownership → PEOU	(not supported)	–
H03	Multimodality → PU	(not supported)	–
H04	Multimodality → PEOU	(not supported)	–
H05	Urbanity → PU	(not supported)	–
H06	Urbanity → PEOU	** (supported)	0.196
H07	Ecological awareness → PU	** (supported)	0.290
H08	Ecological awareness → PEOU	(not supported)	–
H09	Technophilia → PU	(not supported)	–
H10	Technophilia → PEOU	** (supported)	0.242
H11	Car sharing experience → PU	* (supported)	0.177
H12	Car sharing experience → PEOU	(not supported)	–
H13	PU → Behavioural intention to use	** (supported)	0.439
H14	PEOU → Behavioural intention to use	** (supported)	0.405
H15	Car sharing experience → Intention to buy EV	** (supported)	
H16	Car sharing experience → Intention to use EV carsharing	** (supported)	

* $p \leq 0.10$/** $p \leq 0.05$.

5. Conclusion

The aim of this study was to investigate if car-sharing use influences acceptance of electric vehicles as an alternative, more sustainable power train.

5.1. Results

Results partly confirm the main hypothesis: Survey participants with *car-sharing experience* rate *perceived usefulness* of EVs significantly higher than non-experienced participants. This direct effect is mostly not directly attributed to other exogenous variables like *multimodality* or *urbanity*, showing that *car-sharing experience* independently influences *perceived usefulness* of EVs. This result may stem from a mobility-related receptiveness in people who have used or use car-sharing services regularly, showing more trust and interest in mobility innovations like EV and being less bound to the characteristics of a single transport option, especially combustion engine cars with high range. Thus, the hereby proposed different mindset of survey participants with car-sharing experience compared to non-experienced participants may be a subject of further research. However, *car-sharing experience* proves to increase only *perceived usefulness* of EVs and not *perceived ease* of EV use, for which *urbanity* and *technophilia* are the only variables showing causal effects. Since *technophilia* and *ecological awareness* do not interrelate with *car-sharing experience* but have a significant effect on EV acceptance, technologically and environmentally aware people may not belong to the target groups for promoting electric vehicles via car-sharing services.

Additional results show a high intention amongst all user groups to use EV car-sharing if available. This implies that most car-sharing users would switch to EV car sharing if possible and that providers, by offering EVs in their car fleets, could address new target groups. EV car-sharing users rate buying intention significantly higher than non-experienced survey participants, indicating a change of opinion in favour of EV technology when using it in car-sharing services.

Car-sharing experience interrelates with three other independent variables: Higher *urbanity* positively correlates with *car-sharing experience* while *car ownership* negatively correlates with it (and with *perceived usefulness* of EV). Higher *multimodality* goes along with higher likelihood of *car-sharing experience*. Considering the results above, greater EV acceptance could be achieved by addressing highly mobile individuals in urban areas, such as public transport and bike-sharing users, but especially users of traditional car-sharing services by having them switch to EV car sharing. Governmental and private push measures should thus include developing and expanding car-sharing fleets in urban areas, especially subsidising electric vehicles in fleets. Furthermore, pushing modal shift—thus multimodality of individuals and, probably, a change of mindset towards individual transport—in urban areas can serve as a policy measure to push mobility regime change towards EV.

The establishment of EV car-sharing services can thus be regarded as a promising niche which is supervised and promoted by policy. This niche serves two main purposes: First, to create a safe environment in which electric vehicle technology can be developed further and research can be conducted in real-life circumstances, according to Geels and Schot (2007). Secondly, results show a positive attitude towards EV car-sharing usage across all survey groups, indicating trust and high acceptance of this new technology. By introducing people to car-sharing services, including EV, individual mobility habits may change. The results of our study clearly show that a change of opinion favouring EV is currently taking place. Further, from a MLP perspective (Geels/Schot 2007), EV car-sharing services may facilitate the transition of the current automobile regime: EV car-sharing services create niches and test markets, thus raising the observability of a new technology-based

mobility pattern. Users can gather experience, increasing EV acceptance and the likelihood of substituting the combustion engine with the electric engine.

5.2. Limitations

Limitations of this empirical study include a small sample, thus non-representative results. This small sample size is due to the novelty of the technology at the time of the survey and a low number of car-sharing users which scale down statistical population. Since a new and constantly developing technology is surveyed, opinions and acceptance may change fast and are influenced by early adopters, who are highly interested in new products and services. By including early adopters in our sample, opinions surveyed may not represent those of the average population. Nonetheless, they can provide insights into early adoption of innovation in niches and, on a larger scale, initiating socio-technical regime change towards sustainable transport. Therefore, a follow-up study with both early adopters and potential mass-market customers may help gain further insights and monitor changing attitudes.

The study results unfold topics for further research, especially regarding car-sharing companies as system actors that provide access to the innovation and may see it as a business opportunity or as a risk for their services. Additionally, regarding user acceptance, research on individual mobility would be beneficial. This may give a deeper understanding of the interrelations between mobility, car-sharing experience and EV acceptance, since multimodality surprisingly interrelates positively with car-sharing experience but not with EV acceptance in our survey. More detailed empirical research regarding compatibility and evolving long-time habits when using EVs would provide further insights. In the current market diffusion phase of electro-mobility, continuous accompanying research is important to identify possible changes in values, habits and motivations of new and potential users.

Appendix. [10]

Construct/Items[a]	Cronbach's alpha	Kaiser-Meyer-Olkin	Factor loadings
Multimodality	–	0.513	
Choice of transport: Which of the following means of transport do you use regularly? (Possible answers: Car, Bicycle, Public transport, None, Other; asked for three daily mobile situations: ways to work, during leisure activities, running errands)			0.929
Number of transport choices (assessed by combining the regularly used transport choices in all three daily mobile situations)			0.940
Urbanity	–	0.659	
What is the population of your place of residence? (Answers: Less than 100.000, 100.000–250.000, 250.000–500.000, More than 500.000, Don't know)			0.656
How far away do you live from the inner city? (Answers: I live in the inner city, Up to 3 km, Up to 10 km, More than 10 km, Don't know)			0.650
Which of these places are within a few minutes walking distance? (Answers: Supermarket, Electrical supply store, Restaurant, Library, Cinema, Church, Mosque, Opera or theatre, Subway station)			0.813
There are people from many different countries, cultures and age groups in the area I live in.			0.661
Ecological awareness	0.832	0.828	
I worry about the environmental conditions we will live under in the future.			0.776
If we continue with business as usual, we are heading for major environmental problems.			0.842
Politicians do a lot to protect the environment.			0.703
Currently, most people behave with little environmental awareness.			0.443
The importance of environmental problems is exaggerated by environmentalists.			0.732

[10] Survey questions were translated from German.

Appendix (*continued*)

Construct/Items[a]	Cronbach's alpha	Kaiser-Meyer-Olkin	Factor loadings
In favour of the environment, we should all be prepared to limit our living standards.			0.622
Environmental precautions should be enforced even if they cause job losses.			0.777
Technophilia	0.761	0.754	
As soon as a new technological device is available, I am one of the first to buy it.			0.674
When I acquire a new technological device, I am soon familiar with its functions.			0.731
New technology often features functions which appear dispensable to me.			0.523
I hesitate to use new technology because I am afraid to be unable to cope with it.			0.639
It bothers me that new technology is constantly entering the market.			0.715
I rather stick to conventional technology which already proved to be working.			0.764
Car sharing use[b]	–	–	
Have you ever heard of "car sharing"? (Anwers: Yes, No)			–
Have you ever informed yourself about "car sharing"? (Answers: Yes, No)			–
Have you ever used car sharing personally? (Answers: Yes, No, As passenger)			–
With which car types did or do you use car sharing? (Answers: Cars with combustion engine, Cars with electric engine, Cars with another engine type)			–
Perceived usefulness	0.630	0.591	
An electric car is useful in my everyday life.			0.843
An electric car increases my willingness to drive for my mobile routines.			0.727
Generally, electric cars are useful idea.			0.704
Perceived ease of use	0.650	0.649	
It's easy for me to learn how to use electric cars.			0.839
The operation of an electric car is no different to me than that of a conventional vehicle.			0.604
I find it difficult to drive an electric car.			0.847
I find it difficult to charge an electric car.			0.533
Behavioural intention	0.607	0.630	
I can imagine using an electric car for short distances.			0.801
I can imagine using an electric car for medium or long distances.			0.685
I can imagine using an electric car spontaneously.			0.800
Intention to use EV car sharing	0.862	0.500	
If I had access to a car-sharing system using electric cars, I could imagine using it.			0.938
Given the opportunity, I would test electric cars for everyday use with car-sharing services.			0.938
Intention to buy EV	–	–	
Can you imagine buying an EV as your next car? (Answers: Yes, No)			–

[a] All items with no displayed answer possibilities have a Likert-scaled answer range from −10 to +10.
[b] Items in this variable were not used for a scale but only to differentiate between car-sharing users, EV car-sharing users and non-users. Thus, no reliability statistics are displayed.

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